Table 3-1. Waste Receiving and Processing Module 1 Facility Radioactive Emissions Inventory.

Radioisotopes	Average curies/ drum (Ci/drum)	Process rate (Ci/year)
PARTICULATE RADIONUCLIDES		
^{141}Ce	5.28 E-35	1.08 E-30
^{144}Ce, ^{144}Pr	2.54 E-02	5.21 E+02
^{60}Co	1.76 E-02	3.60 E+02
^{137}Cs, ^{137}Ba	8.61 E+00	1.76 E+05
^{155}Eu	4.02 E-05	8.23 E-01
^{147}Pm	1.10 E-01	2.25 E+03
^{106}Ru, ^{106}Rh	4.89 E-04	1.00 E+01
^{90}Sr, ^{90}Y	8.47 E+00	1.73 E+05
^{241}Am	1.41 E-02	2.89 E+02
^{243}Am	2.20 E-02	4.51 E+02
^{252}Cf	3.60 E-03	7.37 E+01
^{245}Cm	1.71 E-04	3.50 E+00
^{238}Pu	3.51 E-01	7.19 E+03
^{239}Pu	6.12 E-01	1.25 E+04
^{240}Pu	1.46 E-01	2.99 E+03
^{241}Pu	2.66 E+00	5.44 E+04
^{242}Pu	8.29 E-06	1.70 E-01
^{232}Pu	1.52 E-05	3.11 E-01
^{233}U	1.81 E-03	3.71 E+01
^{235}U	2.47 E-04	5.05 E+00
^{237}Np	5.63 E-05	1.15 E+00
VOLATILE RADIONUCLIDES		
^{3}H	9.79 E-05	2.00 E+00
^{14}C	3.61 E-05	7.40 E-01
^{85}Kr	5.04 E-02	1.03 E+03

NOTE: Based on processing 20,475 drums per year.

Table 3-2. Emissions Results Based on 40 CFR 61 Methodology.

Radioisotopes	Process rate (Ci/year)	Release rate multiplier	Resultant emission rate (Ci/year)	App. D HEPA adj. factor	Total emissions (Ci/year)
PARTICULATE RADIONUCLIDES					
^{141}Ce	1.08 E-30	0.001	1.08 E-33	0.01	1.08 E-35
^{144}Ce, ^{144}Pr	5.21 E+02	0.001	5.21 E-01	0.01	5.21 E-03
^{60}Co	3.60 E+02	0.001	3.60 E-01	0.01	3.60 E-03
^{137}Cs, ^{137}Ba	1.76 E+05	0.001	1.76 E+02	0.01	1.76 E+00
^{155}Eu	8.23 E-01	0.001	8.23 E-04	0.01	8.23 E-06
^{147}Pm	2.25 E+03	0.001	2.25 E+00	0.01	2.25 E-02
^{106}Ru, ^{106}Rh	1.00 E+01	0.001	1.00 E-02	0.01	1.00 E-04
^{90}Sr, ^{90}Y	1.73 E+05	0.001	1.73 E+02	0.01	1.73 E+00
^{241}Am	2.89 E+02	0.001	2.89 E-01	0.01	2.28 E-03
^{243}Am	4.51 E+02	0.001	4.51 E-01	0.01	4.51 E-03
^{252}Cf	7.37 E+01	0.001	7.37 E-02	0.01	7.37 E-04
^{245}Cm	3.50 E+00	0.001	3.50 E-03	0.01	3.50 E-05
^{238}Pu	7.19 E+03	0.001	7.19 E+00	0.01	7.19 E-02
^{239}Pu	1.25 E+04	0.001	1.25 E+01	0.01	1.25 E-01
^{240}Pu	2.99 E+03	0.001	2.99 E+00	0.01	2.99 E-02
^{241}Pu	5.44 E+04	0.001	5.44 E+01	0.01	5.44 E-01
^{242}Pu	1.70 E-01	0.001	1.70 E-04	0.01	1.70 E-06
^{232}Th	3.11 E-01	0.001	3.11 E-04	0.01	3.11 E-06
^{233}U	3.71 E+01	0.001	3.71 E-02	0.01	3.71 E-04
^{235}U	5.05 E+00	0.001	1.05 E-03	0.01	1.05 E-05
^{237}Np	1.15 E+00	0.001	1.15 E-03	0.01	1.15 E-05
VOLATILE RADIONUCLIDES					
^{3}H	2.00 E+00	1.000	2.00 E+00	N/A	2.00 E+00
^{14}C	7.40 E-01	1.000	7.40 E-01	N/A	7.40 E-01
^{85}Kr	1.03 E+03	1.000	1.03 E+03	N/A	1.03 E+03

NOTES: Based on processing 20,475 drums per year.
N/A = Not Applicable.

Table 3-3. Good Engineering Judgement Radioactive Emissions.

Radioisotopes	Unabated emissions (Ci/year)	HEPA filter DF	Abated emission rate (Ci/year)
PARTICULATE RADIONUCLIDES			
^{141}Ce	1.08 E-33	2.0 E+06	5.40 E-40
^{144}Ce, ^{144}Pr	5.21 E-01	2.0 E+06	1.04 E+06
^{60}Co	3.60 E-01	2.0 E+06	1.80 E-07
^{137}Cs, ^{137}Ba	1.76 E+02	2.0 E+06	8.80 E-05
^{155}Eu	8.23 E-04	2.0 E+06	4.12 E-10
^{147}Pm	2.25 E+00	2.0 E+06	1.13 E-06
^{106}Ru, ^{106}Rh	1.00 E-02	2.0 E+06	5.01 E-09
^{90}Sr, ^{90}Y	1.73 E+02	2.0 E+06	8.65 E-05
^{241}Am	2.89 E-01	2.0 E+06	1.45 E-07
^{243}Am	4.51 E-01	2.0 E+06	2.26 E-07
^{252}Cf	7.37 E-02	2.0 E+06	3.69 E-08
^{245}Cm	3.50 E-03	2.0 E+06	1.74 E-09
^{237}Np	1.15 E-03	2.0 E+06	5.75 E-10
^{238}Pu	7.19 E+00	2.0 E+06	3.60 E-06
^{239}Pu	1.25 E+01	2.0 E+06	6.25 E-06
^{240}Pu	2.99 E+00	2.0 E+06	1.50 E-06
^{241}Pu	5.44 E+01	2.0 E+06	2.72 E-05
^{242}Pu	1.70 E-04	2.0 E+06	8.50 E-11
^{232}Th	3.11 E-04	2.0 E+06	1.56 E-10
^{233}U	3.71 E-02	2.0 E+06	1.86 E-08
^{235}U	5.05 E-03	2.0 E+06	2.53 E-09
VOLATILE RADIONUCLIDES			
^{3}H	2.00 E+00	1.00	2.00 E+00
^{14}C	7.40 E-01	1.00	7.40 E-01
^{85}Kr	1.03 E+03	1.00	1.03 E+03

NOTES: Based on processing 20,475 drums per year.
Assumed stack flowrate = 78,000 ft^3/min.

3.7 OFFSITE DOSES

The Clean Air Assessment Package 1988 (CAP-88) computer code (WHC 1991) was used to calculate effective dose equivalent (EDE) from WRAP 1 to the maximally exposed offsite individual (MEI), and thus demonstrate compliance with WAC 246-247.

3.7.1 Input Data Used

Dispersion modeling was used to demonstrate compliance with the ambient dose standard. Pacific Northwest Laboratory (PNL) developed a radionuclide dispersion modeling methodology manual, *Unit Dose Calculations for Westinghouse Hanford Facility Effluent Monitoring Plans*, in November 1991. The methodology includes the use of unit dose conversion factors developed by PNL for both airborne and liquid pathways for all Hanford Site Facilities. Atmospheric releases were modeled using the CAP-88 (Beres 1990) Environmental Protection Agency-approved code package, and confirming calculations were performed with the GENII (Napier et al. 1988) code.

Airborne releases from generic locations in the 100, 200 East, 200 West, and 300 Area were modeled for both elevated and ground-level releases. The models calculated the EDE to an individual member of the public based on 1-Ci releases. Standard parameters for Hanford dose calculations were included where possible (McCormack et al. 1984). Meteorology data was collected at weather stations in each of the Site's operating areas and represent the 5-year average of data collected between 1983 and 1987. The location of the maximally exposed individual was determined at 24 km (79,260 ft) east of the WRAP facility using the 5-year meteorological data and past studies of 200 West airborne releases.

The unit dose factors resulting from the dispersion modeling are listed in the modeling methodology manual (WHC 1991) in units of mrem/Ci. These conversion factors are multiplied by the estimated controlled emissions rates expected from the WRAP 1 facility. The results are presented in Table 3-4. Some of the parameters used in the modeling are listed below:

- Source Terms--Projected annual releases from WRAP 1 as presented in Table 3-3, Good Engineering Judgement Radioactive Emissions.
- Release Height--The height the emissions release was taken (i.e., ground level or zero).
- Inhalation Rate--An individual was assumed to breathe 8,500 m^3/year (300,173 ft^3/year).
- Maximally Exposed Individual--Doses were estimated for an individual living 24 km (10 mi) east of the WRAP 1 facility.
- Meteorology--The Hanford Meteorological Station (HMS) data and onsite meteorological data were used (WHC 1991).

3.7.2 Results

Table 3-4 shows the dose factors derived from the CAP-88 modeling and the EDE for each radionuclide. The source term (i.e., emissions after abatement in Ci/year) are multiplied by the dose factors to obtain the EDE. The total projected EDE from controlled airborne radiological emissions to the offsite MEI is 1.34E-03 mrem/year. The dose attributable to radiological emissions from WRAP 1 will, then, constitute 0.013 percent of the WAC 246-247 EDE regulatory limit of 10 mrem/year to the offsite MEI.

For comparison, the natural background radiation dose for the Tri-Cities (i.e., the cities of Richland, Kennewick, and Pasco) area of Washington State is estimated to be 300 mrem (Jaquish 1989). The projected EDE to the MEI from the WRAP 1 facility would constitute 0.00045 percent of the natural ambient radiation.

Table 3-4. Waste Receiving and Processing Module 1 Facility Effective Dose Equivalent Estimates for an Individual Receiving Maximum Exposure to Radiological Emissions.

Radioisotopes	Abated emission rate (Ci/year)	Modeled dose factor (mrem/Ci)	Abated MEI dose (mrem/year)	Percent of abated MEI dose
PARTICULATE RADIONUCLIDES				
^{141}Ce	5.40 E-40	8.14 E-03	4.40 E-42	3.29 E-37
^{144}Ce, ^{144}Pr	2.60 E-07	8.14 E-03	2.12 E-09	1.58 E-04
^{60}Co	1.80 E-07	1.72 E-02	3.10 E-09	2.32 E-04
^{137}Cs, ^{137}Ba	8.80 E-05	1.42 E-02	1.25 E-06	9.34 E-02
^{155}Eu	4.12 E-10	1.16 E-03	4.80 E-13	3.59 E-08
^{147}Pm	1.13 E-06	6.75 E-04	7.63 E-10	5.70 E-05
^{106}Ru, ^{106}Rh	5.01 E-09	1.24 E-02	6.21 E-11	4.64 E-06
^{90}Sr, ^{90}Y	8.65 E-05	2.60 E-02	1.25 E-06	9.34 E-02
^{241}Am	1.45 E-07	7.79 E+00	1.13 E-06	8.44 E-02
^{243}Am	2.26 E-07	7.79 E+00	1.76 E-06	1.31 E-01
^{252}Cf	3.69 E-08	NA	NA	NA
^{245}Cm	1.74 E-09	NA	NA	NA
^{237}Np	5.75 E-10	7.05 E+00	4.05 E-09	3.03 E-04
^{238}Pu	3.60 E-06	4.76 E+00	1.17 E-05	8.74 E-01
^{239}Pu	6.25 E-06	5.15 E+00	3.22 E-05	2.41 E+00
^{240}Pu	1.50 E-06	5.14 E+00	7.71 E-06	5.76 E-01
^{241}Pu	2.72 E-05	8.17 E-02	2.22 E-06	1.66 E-01
^{242}Pu	8.50 E-11	5.15 E+00	4.38 E-10	3.27 E-05
^{232}Th	1.56 E-10	4.83 E+00	7.53 E-10	5.62 E-05
^{233}U	1.86 E-08	1.92 E+00	3.57 E-08	2.67 E-03
^{235}U	2.53 E-09	1.76 E+00	4.45 E-09	3.32 E-04
Subtotal Particulate Radionuclide Dose			5.93 E-05	4.4276
VOLATILE RADIONUCLIDES				
Subtotal Volatile Radionuclides			1.28 E-03	95.5724
TOTAL ABATED DOSE			1.34 E-03	100.00

NOTES: Based on processing 20,475 drums per year.
Assumed stack flowrate = 78,000 ft^3/min.